AN APPLICATION OF GAMES TO INSTRUCT JUNIOR OFFICERS IN FLEET ASW HELICOPTER SQUADRONS

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the requirements for the degree of

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ABSTRACT

Modern war games can be divided up into three groups: computer games, computer assisted games, and manual war games. These games can be used in any one of three ways: for enjoyment, as an analytic tool, or as an aid to training.

This paper develops a manual war game that can be used as a training aid in an ASW helicopter squadron. ASW Simulation is designed to aid the novice pilot in learning the basic concepts of helicopter ASW by simulating some of the problems that may be encountered by a flight of three helicopters in a combined ASW exercise.

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THE PROBLEM

Theoretical Background.

Ever since the modern war game was invented in 1824 by Lieutenant Von Reisswitz of the Prussian Guard Artillery, games have been a useful tool in military circles the world over.[1] Many new techniques have been introduced, and the style of play has evolved and progressed much as our technical knowledge has progressed. Many parlor games per se, have been considered war games by some individuals.[2] Besides enjoyment there is a certain advantage to be gained through the attitude change that takes place in the player because of the game. Usually a person acquires a new perspective and frame of reference from the game play which they would not otherwise derive from study alone. Even in a game of checkers the advantage and power of a King is not lost upon a child's impressionable mind.

War games, or for that matter any game, can satisfy certain needs and fulfill different goals depending upon the goals of the individuals involved. Probably if asked to classify the different uses of war games, one would say that they are used for enjoyment, analysis of a problem, or as an aid to learning or training. A person cannot readily establish in which of these roles a war game is most valuable. Generally we can say that the war game will assume the most importance in the role which has the greatest intrinsic value to the players and administrators.

[1] Francis J. McHugh, "Gaming at the Naval War College," United States Naval Institute Proceedings, 90: 48, March, 1964.

[2] Clark C. Abt, "War Gaming," International Science and Technology, 32: 29, August, 1964.

Games can probably best be divided into three distinct types:

a. Computer games
b. Computer assisted games
c. Manual games

In the computer game the players' play, or move, is fed into a computer. The results of this move or decision is calculated in the computer and returned to the players for their consideration. These results usually will indicate some measure of advantage to one or the other player. In other words, even though you may not be able to specifically indicate who won the game, there is usually some measure which indicates which player ended up in a more favorable position. This last characteristic described is not necessarily unique to the computer game; it can be applied to other types of games as well. The unique part is that the judgment of all outcomes is performed as a function of some mathematical equation that is manipulated by a computer.

The second type of game is the computer assisted game. This game is a mixture of the computer and manual game. It is referred to as "computer assisted" because the umpire is human, but requires the assistance of the computer for bookkeeping and quantitative decisions. This type of game allows the best of both worlds to come into play since the speed and accuracy of calculation in the computer is available to the human umpire.

The third type is the manual game, so designated because the bookkeeping is done entirely by hand, usually by an umpire or his assistant. It is for this reason that this game is the most time consuming of the three types of games studied. A distinct advantage to the manual game is the ability of the umpire to handle an unexpected turn of events, something which is bound to happen even with the most rational of players. It is this type of game which will be developed in this paper.

There are four decisions that must be made about a game prior to its inception. The decisions are: first, the objective of the game; second, selection of personnel, both as players and umpires or administrators of the game; next, a selection of a time and place to play the game; last, a method of collection and evaluation of data.[3] Once these decisions have been made then the game may be constructed and played.

Generally speaking almost any war game can be divided up into three separate phases. Although the dividing line between each one of these phases may not always be clear and distinct, they may be thought of as:

1. A preparation phase.
2. A game phase
3. A critique phase[4]

Preparation Phase. This phase of the game, as the name implies, deals with the preparation of both the players and umpires for the game. During this phase the rules of the game are discussed and the players are acquainted with the general framework of the game and the tools which they will be required to use during the game. These tools can include any special forms or mechanical devices which are required for the game play. The players and umpire should discuss an example of game play and cover the scenario of the game. A brief question and answer period should follow to cover any pertinent points that were not made clear to the players earlier in the phase.

Game Phase. During the game phase, the players and umpires retire to the area selected for playing the game. The umpire should note the time that play actually commences and attempt to control the game so that the players will not run over the time allotted for the game. During the

[3] J. B. Phillips, "Manual War Gaming," First War Gaming Symposium Proceeding, 30 November, 1961, John Overholt, editor (Washington, D.C.: Washington Operations Research Council, 1961), pp. 7-8.

[4] Ibid., pp. 8-12.

game phase, both the umpire and the players should make notes on points that they will want to cover in the critique phase.

Critique Phase. The critique phase probably is the most valuable phase of the game. During this phase the players and the umpire should cover the game as it was played and discuss the various concepts that were covered, or intended to be covered, in the game. Suggestions may be made at this time to improve the game play. This may include the addition of new parts or the deletion of outmoded parts of the game. Throughout this discussion, hopefully, both players and umpires will be gathering information about the game and the basic principles involved.

Statement of Purpose.

The purpose of this paper is to devise a manual war game that can be used as an aid to training in an antisubmarine warfare helicopter squadron. Specifically, it should be used for the development and training of junior officers who have just entered the squadron. The game is designed to present some concepts about antisubmarine warfare framed within the context of an ASW exercise. Because the player actually is confronted with simulations of problems which could present themselves in an actual ASW exercise, the game can speed and aid the individual's learning process. Finally, this game is supposed to instill interest and enthusiasm for ASW, specifically the use of helicopters in ASW.

The Problem.

The problem envisioned is to develop a manual war game that can be used as a training aid. This game should teach basic concepts to inexperienced pilots who are in training to learn principles and procedures for the use of helicopters in ASW. There are several basic concepts which this game should cover. They are:

a. Navigation

b. Time Management

c. Tactics

d. Sonar capabilities and limitations

e. ASW weapons capabilities and limitations

f. General squadron procedures and practices

Definitions.

The following is a list of definitions which are peculiar to anti-submarine warfare and this game:

ASW - Antisubmarine Warfare

Ceiling - The lowest altitude where the cloud cover is more than eight tenths.

Conventional Weapon - Any weapon other than a nuclear weapon.

Flow Diagram - An illustration of the branching of decisions and actions included in the game.

IFR - Instrument Flight Rules. Indicates that the aircraft is operating in other than visual conditions.

Probability of Detection - The probability that a submarine will be detected. In this particular game the probability the submarine will be detected by a particular sonar in a certain helicopter during game play.

Random Number - A number taken from the random number table where the probability of drawing any particular digit is equal to the probability of drawing any other digit. Almost any random number table included in any book of standard mathematic tables is suitable for the purposes of this game.

Subroutine - A portion of the entire routine or program.

Assumptions.

The following assumptions apply to this game:

Locale. The locale envisioned by the author for the game devised in this paper is San Diego, California. Although this game is related to this particular area, the assumption is made that even though sonar, weather, and topography will vary considerably from area to area, this will not hamper the simulation of the problem. The scenario and problem inputs can easily be adapted to typify different areas if desired.

Squadron type. The type of aircraft considered here is the SH - 3A presently employed in the fleet. This helicopter is presently equipped with the AQS - 10 sonar. It is assumed that any differences in aircraft type that seriously affect the game, can easily be incorporated into the scenario and problem inputs.

The Players. It is assumed that each of the players have at least two years of college level education, approximately 200 to 300 flight hours with about 50 to 100 hours in type and, although he is a novice, has been exposed to some of the rudimentary aspects of ASW.

The Umpire. It is assumed that the game's umpire also has at least two years education at the college level and a minimum of 600 flight hours with approximately 300 in the type of helicopter which the squadron presently employs. It is further assumed that he has been a member of the squadron for one year or more and has participated in many variant forms of ASW exercises.

Limitations.

Since the ASW game described in this paper is a manual game (i.e., played in a room with pencil and paper), there is an obvious loss of realism. Since this has not seriously affected other games it is felt that the loss of effectiveness in this case will be negligible.

The assessment of probabilities, a difficult matter in many real life situations, is another limiting factor. Since the probability of detection depends upon so many variable parameters, the overlays included within the game can hardly be considered technically accurate for every situation. Since the purpose of the game is to aid learning and not to analyze the effectiveness of tactics or search plans very little is lost to the value of the game.

One area that causes a considerable lag in game play is the manual bookkeeping that is required. This detracts somewhat from the time compress that the player is subjected to in an actual situation. The more proficient

that an umpire becomes in the administration procedures of the game the less the limitations of the manual bookkeeping will be noticed.

Research Significance.

Training junior officers in the complex art of ASW is one of the more pressing problems that confronts helicopter squadrons today. The number of personnel available to train new personnel is just as critical as the very limited number of qualified personnel assigned to the ASW helicopter squadrons.

The heart of the training problem is the efficiency with which the training is conducted. The faster that junior officers are taught the everyday procedures of the ASW problem and what is expected of them, the sooner they will be able to be utilized in the all-out effort by the U. S. Navy to maintain the freedom of the seas. Without a doubt there is a definite requirement for well-trained and experienced personnel to attempt to solve the multitude of problems involved in this endeavor. The amount of money spent in training personnel is considerable and the payoff is something that can only be measured by success in a wartime situation. The training today is conducted under conditions which are supposed to closely approximate those of a wartime situation. Because due consideration must be given to safety, many people claim that effectiveness is hampered considerably. Hopefully, training through war games can enhance the safety record we already enjoy.

The average helicopter pilot arrives in the squadron with approximately 300 to 400 hours of flight time, the main portion of which is performed in basic and advanced flight training in Pensacola. Somewhere between 50 and 100 hours of this time is spent learning to fly the operational type aircraft that his squadron employs. This flight training is performed under the careful guidance of experienced aviators who have just returned from a tour of duty in an operational squadron. During his stay at the Replacement Training Squadron the newly designated naval aviator spends a considerable amount of time attending schools in an attempt to become familiar with the rudimentary

concepts that he will use in the squadron. With all due respect for the training that the average junior officer receives prior to joining the squadron he still requires training and experience before he becomes effective.

Once a junior officer joins an operational squadron he is incorporated into the squadron's training syllabus. Since he has already attended a required series of schools in the Replacement Training Squadron, primary emphasis is placed upon an internally administered lecture series and flight training program with experienced squadron personnel. At the present time, war games are not used as a training tool at the squadron level. There is one exception to this: the games played at the ASW school. Although these games are realistic and valuable, their one drawback is that they require representatives from all of the units of an ASW Group (i.e., VS, Destroyers, Flag Staff, CVS, etc.) in order to play. Collection of a group of personnel that size isn't done often and usually only under extraordinary conditions. One other point that should be noted is: the electrical mechanical equipment and the spaces used to simulate the game conditions at the ASW school are not only large but expensive. Budget limitations will not allow a squadron to purchase or maintain the equipment required for these games.

CHAPTER II

THE STUDY

Methods.

Evaluating the effectiveness and validity of any game is a difficult proposition. One method is to compare the war game methods withthe previous training techniques. Since this particular war game is designed primarily to supplement rather than supplant the present training program, this mode of analysis will not suffice. One method would be to divide the population input of junior officers into two segments, or samples, for a period of time. One group would receive the normal training and the other would receive essentially the same training but supplemented with the ASW war game. As each group completed some phase of their overall training they could be examined with both a written and oral test to measure their knowledge of the subject field of ASW. A more effective method would be to have each group rated by the pilots that they fly with during their first five training flights on ASW exercises. Such a rating should include an evaluation of the pilot's overall knowledge on navigation, communications, system capabilities, weapon capabilities, and tactics. A statistical analysis of the results of this project should aid in evaluating the effectiveness and validity of the ASW game.

Materials.

Game board. The game board is a plywood board approximately 30"x30". A large sheet of graph paper or engineer's paper is attached to the board. The small grid on the graph paper is approximately one quarter inch on a side, and represents 200 yards. The graph area should encompass an area of approximately 22" x 22" on the board and should be covered with a clear plastic material suitable for plotting unit positions with a grease pencil. This plastic or acetate covering should be stretched taut and firmly attached on all four edges with masking tape.

Game book. The game book, which is kept by the umpire, contains: the introductory remarks, the scenario for the brief, and the problem forms for the players. Each of the pages in this book should be encased in a clear plastic acetate filler and should be of the three ring looseleaf binder type. The acetate coverings provide a dual service; they prevent the problem forms from being soiled from handling, and they provide an easy method for the umpire to alter the problem with a grease pencil.

The problem form. Examples of the problem forms for this game can be found in the appendix. These forms should be kept in the game book in the same sequence as the flow chart for the game. Several of the problems in the game book are written in a "fill in the blanks" format. By filling in the blanks with required information the umpire can easily control the magnitude and nature of the problem inputs. Since the problems are in a looseleaf notebook they can be programmed by: changing their sequence, skipping over problems which are not desired, or removing them entirely from the book. This permits the umpire considerable flexibility in administering the game. In the event that a problem produces a response from the players in which there is no follow on problem already enclosed in the game book, and where its omission would cause an illogical gap in game play, the umpire is able to cope with the situation in one of several ways: he can clarify the situation verbally, he can print a new problem with a grease pencil on one of the blank problem forms stored at the back of the game book, or he can use a combination of both of these methods. These problem forms should be presented to the players for their consideration and then returned to the game book.

Decision/Communication form. The Decision/Communication form has three items printed on it. At the top of the page the word "Decision" is printed. In the space below this the players are required to write out any decisions that they would make or actions they would take to solve the problem confronting them. It should be emphasized to the players that their

writing style and format need not be elaborate. A concise legible statement covering the major points of the problem is desired. Approximately half the way down the page the word "Communication" is printed. If the action that the players take in the decision portion of their answer would normally require some sort of communication, either by radio or visually, a quotation of the actual words they would use or a description of the visual signals should be entered here. At the bottom of the page the word "Remarks" is printed. This space can be used by either the players or the umpire. If there is some point about the problem that the players don't understand, or they feel requires clarification, they can make a notation of it here. When the umpire receives the Decision/Communication form back from the players he can make a notation about the problem and the amount of time that it took the players to make a decision. Any remarks made on this form should be discussed in the critique phase of the game. An example of this form can be found in the appendix.

Plotting instruments. There are several instruments used by both the players and the umpire to mark positions, times, ranges, and bearings on the game board. A black grease pencil is a minimum requirement. Colored grease pencils may be used for clarity at the discretion of the umpire. A clear plastic straightedge, preferably graduated in a scale that is equal to the scale used in the grid on the game board, and any clear plastic protractor will allow the players or the umpire to get a close cut on a bearing line and range from any position on the grid.

Computer. One of the articles which the player would have with him in the aircraft would be a circular slide rule. The use of this in the aircraft during ASW exercises can alleviate many of the time consuming computations usually required. The use of this slide rule in the game should be encouraged to enhance the players' proficiency under actual conditions.

Clock. A false clock is used in the game to simulate time passage. A cardboard face with the minutes marked on it and a minute hand that can be set to any position will suffice. The umpire controls the time indicated on

the clock so that the players can envision the elapsed time in the simulation they are involved in. While the flight is enroute to datum, the clock time represents elapsed time since takeoff. Once at datum the clock represents the elapsed time since datum time. While returning from datum the clock represents the elapsed time since departing datum.

Overlays. Several different overlays are required to assist the umpire in assessing the outcome of the game as depicted on the game board. These overlays can be constructed on tracing paper or frosted acetate. The overlays used are as follows:

1. Submarine Escape Plan
2. Sonar Detection Probability
3. Environment
4. Weapon Effectiveness

A brief discussion of the overlays and their use is as follows:

1. Submarine Escape Plan - Ten submarine tracks should be plotted. The track should begin at a small square which will represent the last known datum position on the grid of the game board. The track should represent a fairly random selection of direction to simulate evasion. Points of time should be spaced to scale, depending upon the chosen speed of the submarine. For simplicity it is convenient to use the same speed throughout the track. The speed used on each individual track can vary from one to nine knots. For this particular game three tracks were developed for a nine knot submarine, three for a six knot submarine, and four for a three knot submarine. These tracks are numbered from one to ten and the umpire decides which one will be used by selecting a random number from a random number table. The first digit of the number selected will dictate the track to be used. The umpire keeps this track in another area where the players can not see it and uses it to assess the probability of detection from a given helicopter position on the game board. This is done by using this overlay in conjunction with the Sonar Detection Probability overlay. A typical example of one of the submarine escape plans can be found

in the appendix.

2. Sonar Detection Probability - One Sonar Detection Probability overlay is used in this game. The overlay consists of concentric rings expanding out to some given distance from the helicopter's position on the grid. The closer to the helicopter's position the higher the probability of contact. Conversely, the further away the submarine is from the helicopter the lower the probability of contact. The umpire determines whether or not sonar contact is made by placing the submarine's escape track down on the game board with the origin at datum. At any point in time the helicopter position is noted and the submarine position is noted. If the submarine's position at that time falls within one of the concentric rings, the probability of detection is equal to the numerical figure listed in that ring. The umpire then draws a random number from the random number table. If the number is less than or equal to the probability of detection, then sonar contact is gained for that helicopter. An example of the Sonar Detection Probability overlay can be found in the appendix.

3. Environment - Two environment overlays are used to indicate false contacts. These false contacts are plotted as seaweed, schools of fish, pinnacles or other marine life or phenomena and apply only when one falls within one of the concentric rings of the sonar detection probability overlay. Examples of the environment overlays can be found in the appendix.

4. Weapon Effectiveness - Several different overlays can be plotted on one sheet in this case. Areas are marked out and the probability of a kill with a particular weapon are noted in each of the different areas. To construct one of these overlays the umpire will be required to use the latest weapon data available. An example of the weapon effectiveness overlay can be found in the appendix.

Texts or tacaids. A pilot in an actual situation would normally have several publications, or reproductions of publications, in the cockpit to aid him in decision making. The players can either have these available to them, or they can have the actual publications depending upon which ones the

umpire feels the players should become familiar with during the game.

Procedures.

General.

1. Manual play - The ASW game developed here requires all manual inputs and outputs. The game itself is designed to operate with two players and a minimum of one umpire. The umpire who administers the game should be well versed in ASW helicopter tactics and the particular doctrine employed by the squadron to which the players are assigned. In most instances the game can and should be administered by the squadron's ASW officer or one of his assistants. If more than two players (i.e., more than one pilot and co-pilot) desire to play the game at one time, separate umpires will be required to administer the game to each team. Since the input of junior officers to a squadron, under the level readiness concept of pilot rotation, is distributed over a period of time rather than all at once, the fact that this game is designed for only a few players at one time should not be particularly disadvantageous.

2. Inputs - Each input to the players is designed either as a problem or as a note of information to assist the players in envisioning the situation. All of the inputs for the game, their format, chronology and timing are controlled by the umpire. Examples of the problem inputs can be found in the appendix. They are labeled with form numbers to clarify the explanations of the subroutines.

3. Decision and time - Once the players receive the inputs from the umpire they are required to make some sort of decision. This decision can deal with: formation dispositions, tactics, speed and altitude of flight, navigation or communications. The time allowed for each decision and the time required to transfer these decisions to an output form (Decision/Communication form) is again controlled by the umpire. As the players become more proficient at the game the umpire can allow them less time to make their decisions.

4. Outputs - Once the players make their decision and transcribe these decisions to a Decision/Communication form the umpire will evaluate their answer to see if further information on a particular point is needed prior to proceeding to the next stage in the game. In many cases the eventual outcome of the players' decisions are decided through the use of a random number table. The nature of such functions as time delay, sonar detection probabilities, and weapon kill probabilities are sufficiently random in nature to allow the monte carlo technique to provide the element of chance to the game.

5. Flow diagram - The complete flow diagram of the game and all of its subroutines can be found in figures one through ten.

The Game

This game is divided into three phases:

1. Preparation phase

2. Game phase

3. Critique phase

A description of each of these phases follows:

1. Preparation phase - The preparation phase includes an introductory remark by the umpire. This introduction is intended to familiarize the players with the game and give them some ideas of the rules under which they will play the game. The rules are designed to be flexible and allow freedom of action and thought whenever possible. Final adjudication of the rules rests with the umpire. After the introduction the umpire asks if there are any questions about the game or the mechanics of play before going into the next phase. An example of the introductory statements by the umpire to the players can be found in the appendix.

2. Game phase - The second phase is the game phase. In this phase the umpire reads the scenario of the game to the players. This is supposed to simulate a normal briefing that is given to the pilots prior to the time they go on a mission. After the umpire completes this briefing, one of the players

presents a flight leader's brief on what they plan to do on the flight. During this briefing the umpire should note areas requiring comment during the critique phase. Upon completion of all questions and answers the players and umpire commence play of the game. A description of the game play involved and explantions of the flow diagram follows.

The game play during the game phase can best be visualized as consisting of a basic program divided up into eleven subroutines. Figure 1 represents the basic program for game play. Each of the eleven subroutines contains either a concept that the player is to be presented with or represents a method of determining a parameter necessary for game play. For simplicity we will discuss each subroutine separately.

Formation Subroutine, (Fig. 2). The umpire begins this subroutine by setting the clock to one and informing the players that the time on the clock represents the elapsed time since their flight took off. The players are then asked to make a decision on what type of formation they will use to get to the exercise area (see form no. 1). The players' decision and the advantages or disadvantages of different types of formations can best be discussed at the critique. Since this is the first subroutine, the umpire may wish to make suggestions on format and style of writing. This will assist the players later on in the game when they are required to develop more difficult decisions and communications in writing.

Flight Out Subroutine, (Fig. 3). In this subroutine the umpire will reset the clock to two and pose the problem of what course and speed the flight will use to get to the exercise area (see form no. 2). In ASW, as in every other type of warfare, timing is of the essence. The players decisions in this subroutine should be discussed in the critique with this idea in mind. If the course and speed are not proper the umpire can simulate a corrective suggestion from the players' wingman (see forms no. 3&4). Once the players have selected a proper course and speed to get them to the exercise area, they can move on to the next subroutine.

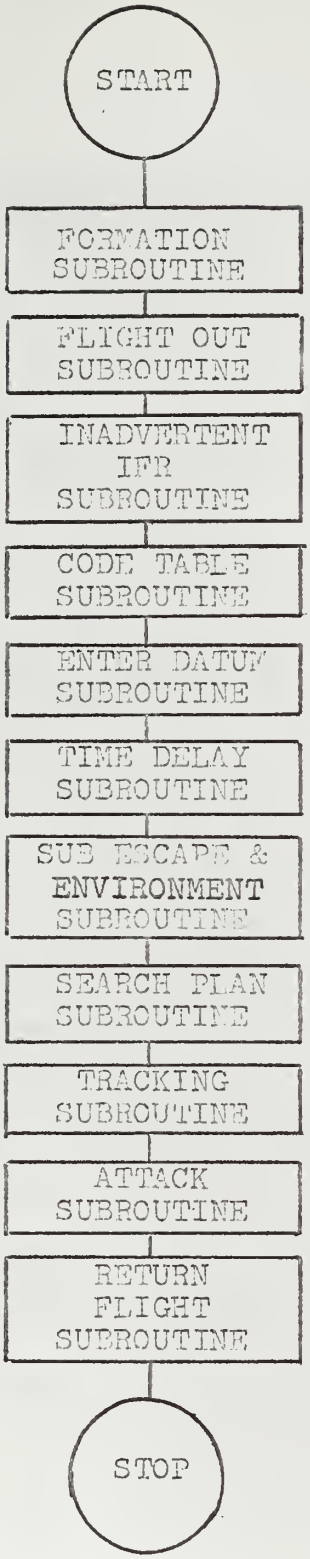

Figure 1: Flow Diagram Game Phase.

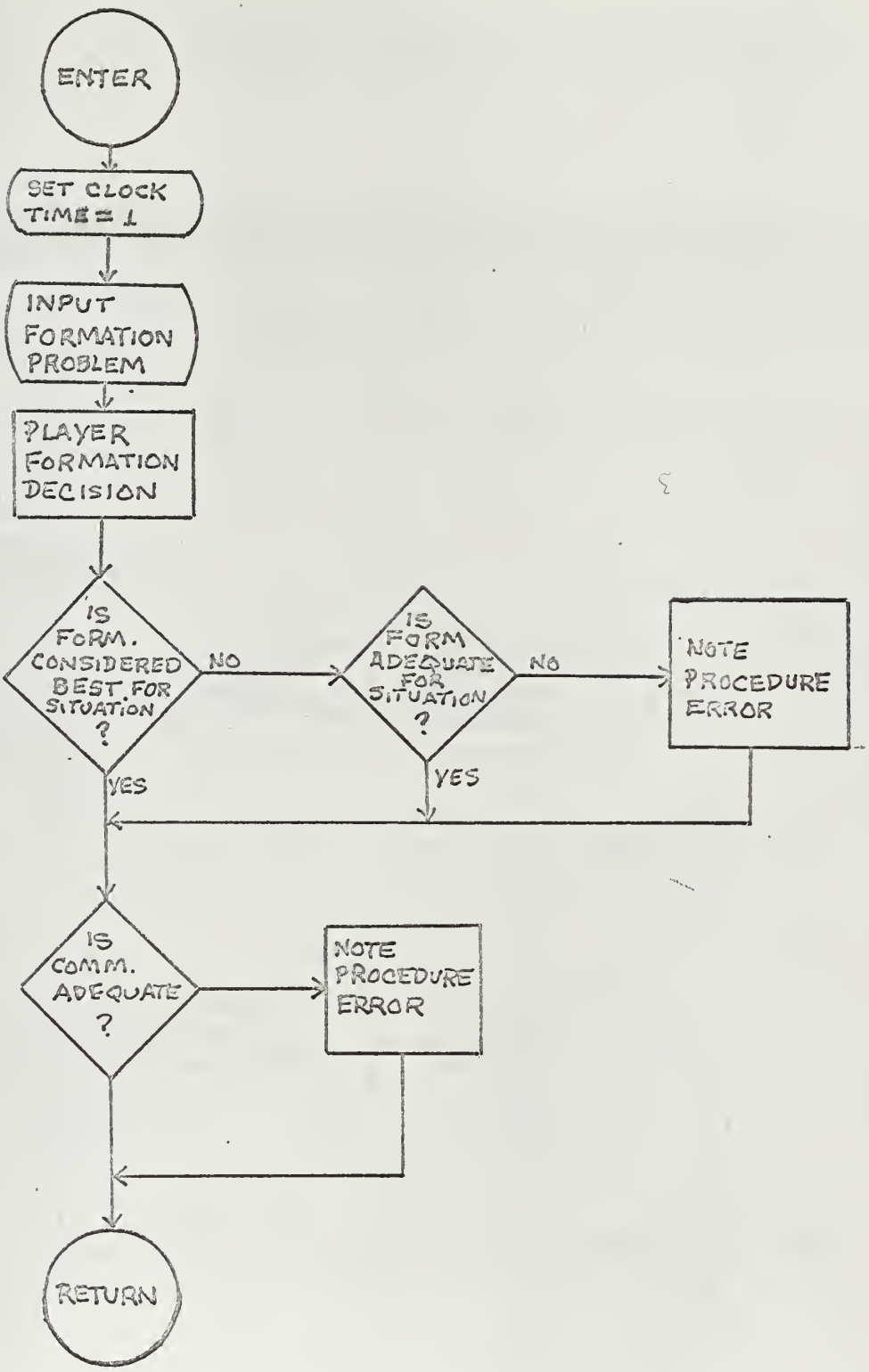

Figure 2: Formation Subroutine.

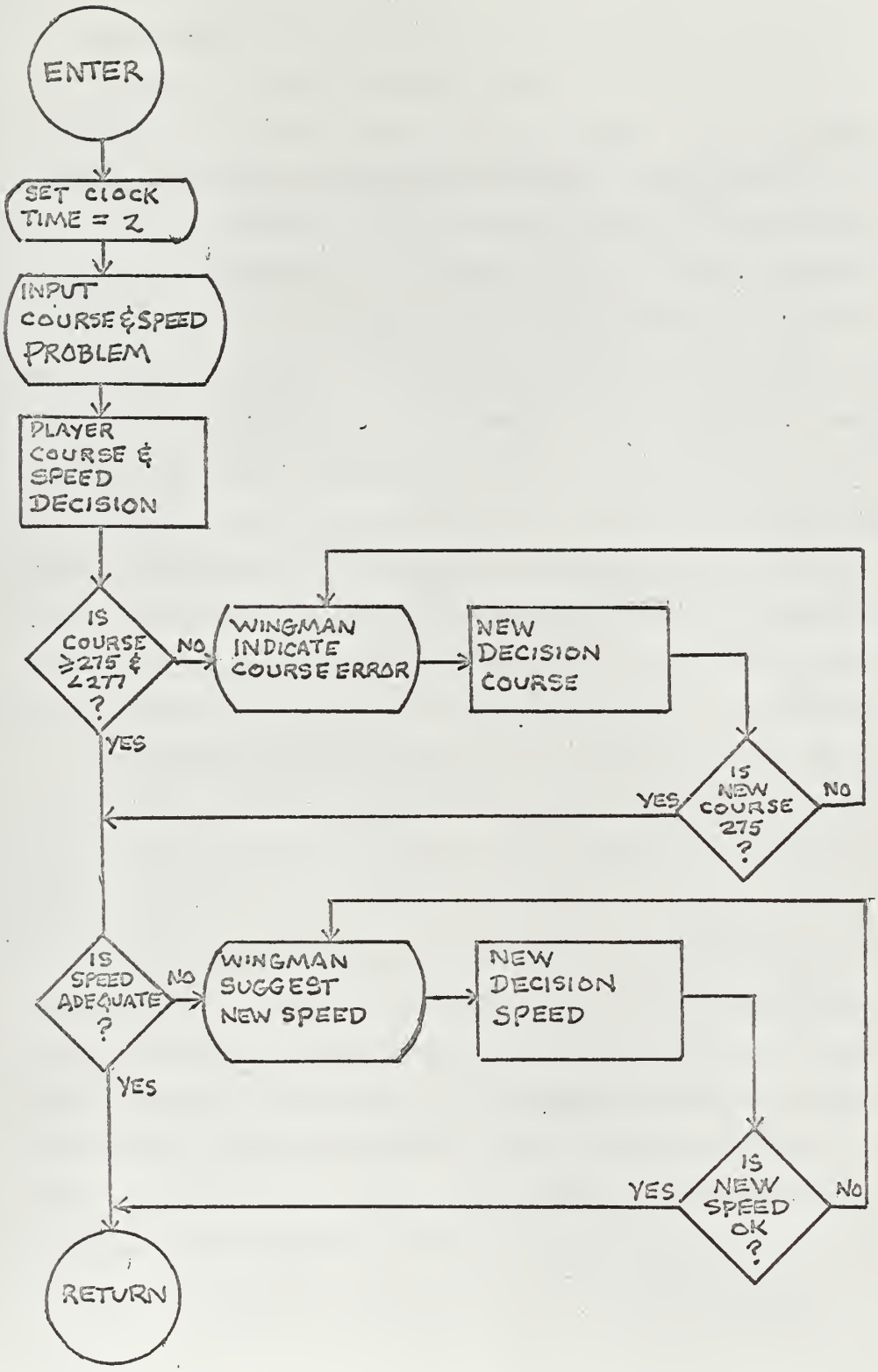

Figure 3:Flight Out Subroutine.

Inadvertent IFR Subroutine, (Fig. 4) In this phase of the game the umpire sets the clock to ten and poses the problem of what action the players will take when confronted with a fog bank (see form no. 5). If the players elect to go underneath, the umpire can simulate the flight's inadvertent entry into IFR conditions and assess the probability of a midair collision by drawing a random number from the random number table (see forms no. 6&7). If the number drawn is less than or equal to two (i.e.,the probability of a midair is = .02) he can inform the players of the midair collision (see form no. 8). Otherwise, he can simulate the flight extricating itself from its predicament and continuing on top of the overcast (see form no. 9). In the event that this subroutine results in a midair collision, the umpire will be required to decide if the game should be continued. If the players will not be available to play again, the game should be continued. If the players will be available at a later date, the game should be terminated with the understanding that the players will return.

Code Table Subroutine, (Fig. 5). The umpire sets the clock to twenty-three. This should indicate to the players that they are nearing the exercise area. The umpire then simulates some radio transmissions between the fixed wing aircraft and the destroyers (see form no. 10). He notes what information the players can glean from the simulated radio transmissions and what procedures they take once they have received this information. If the players fail to attempt to locate the units with their ADF or don't report their presence in the area to the task unit commander then the umpire can simulate a request for a report (see form no. 11) and penalize them by increasing their time delay in reaching datum. These penalties should be emphasized in the critique after the game.

Enter Datum Subroutine, (Fig. 6). In this subroutine the umpire sets the time clock to twenty-five and hands the players the problem form that tells them to join the fixed wing aircraft (see form no. 12). If the players fail to get a steer to the fixed wing aircraft the umpire can hand them another problem

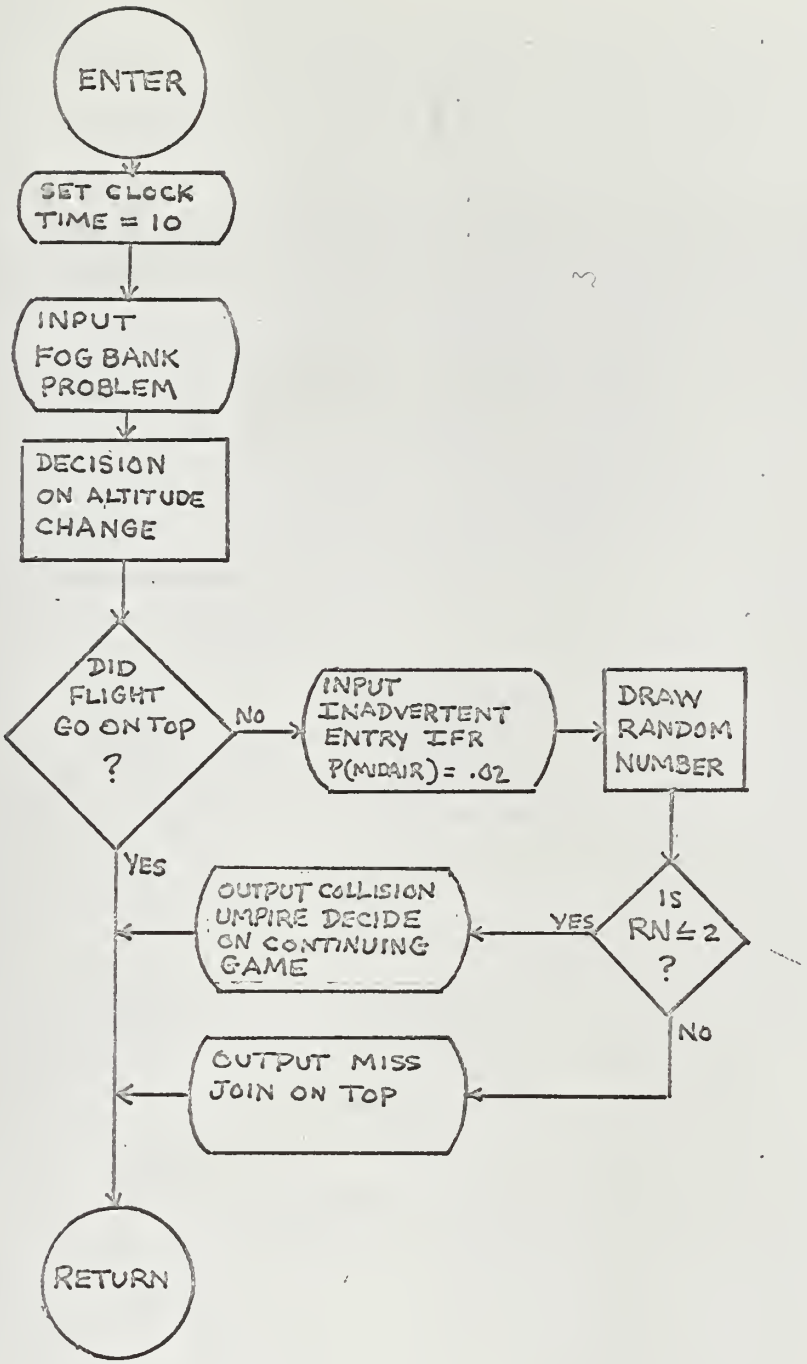

Figure 4: Inadvertent IFR Subroutine,

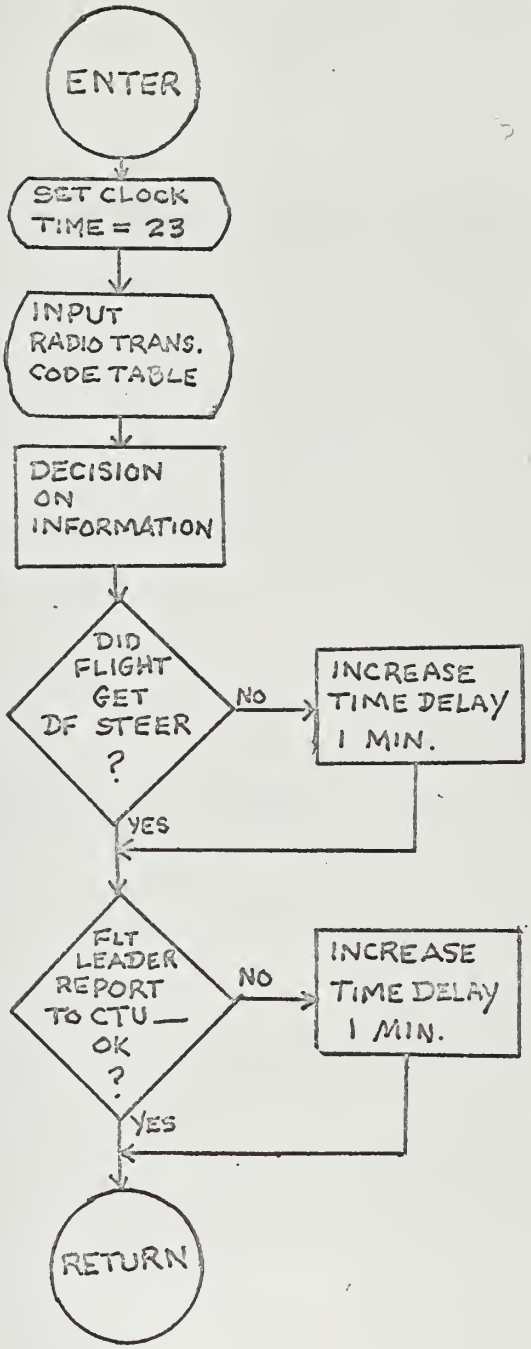

Figure 5: Code Table Subroutine.

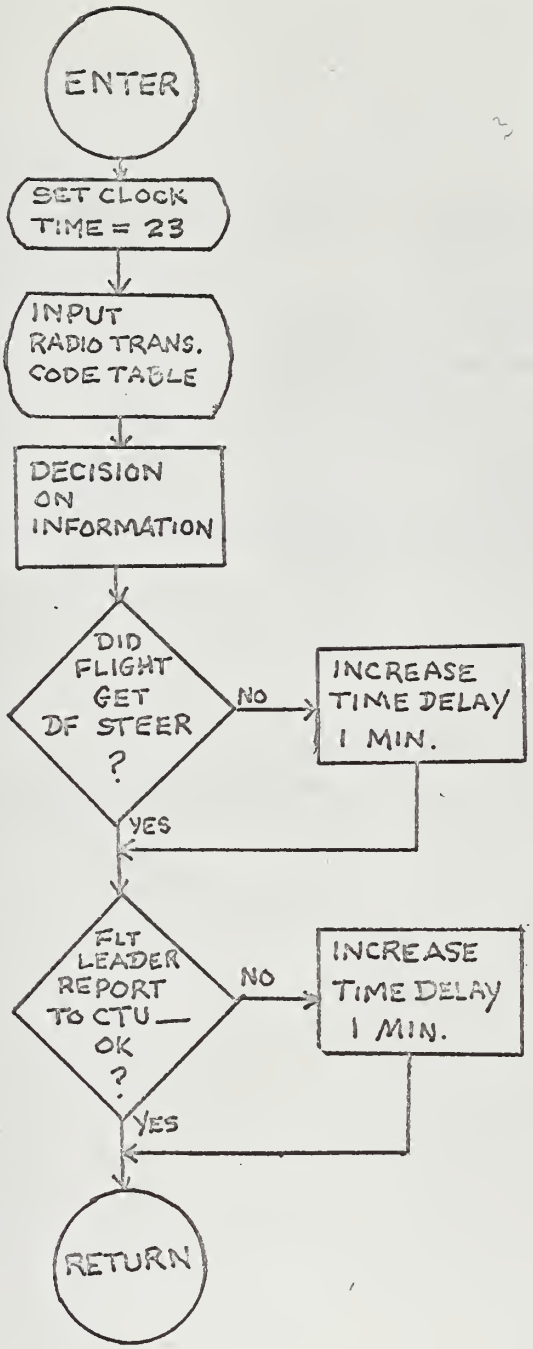

Figure 5: Code Table Subroutine.

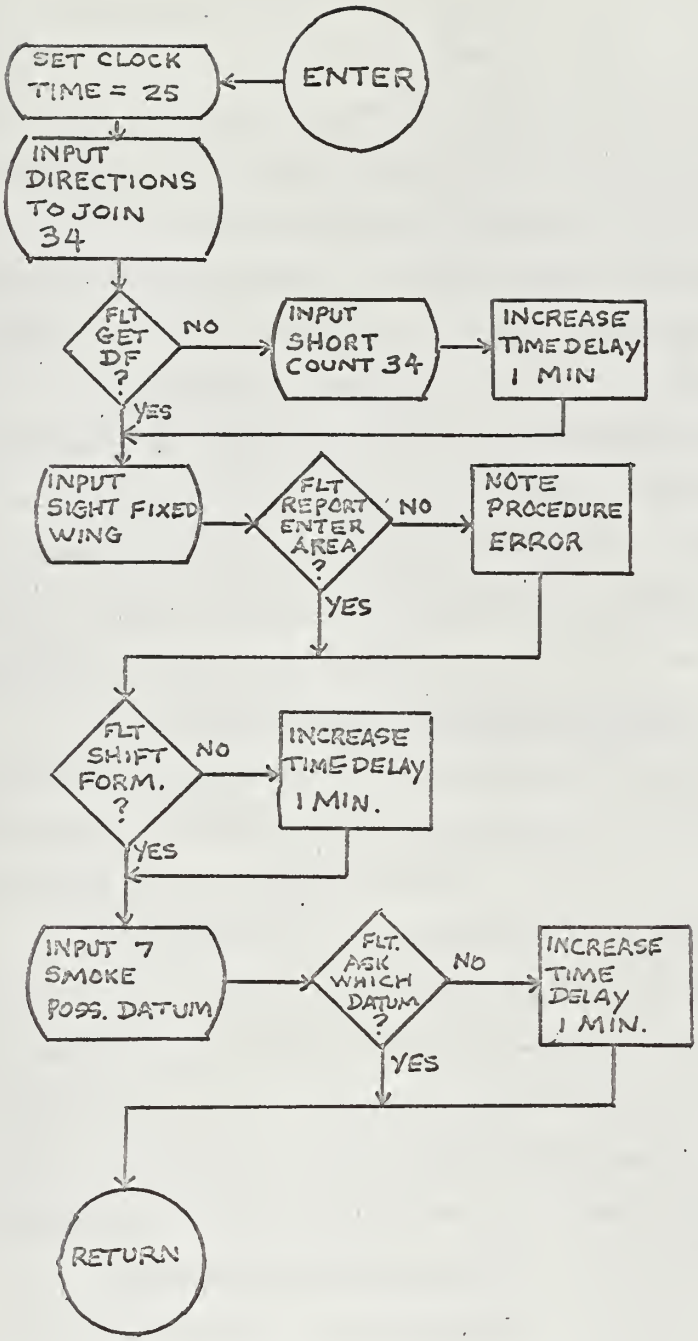

Figure 6: Enter Datum Subroutine.

form with a short count (see form no. 13) on it and penalize the players by adding a minute to their time delay at datum. The next input problem to the players is a description of the scene at datum (see form no. 14). In case the players forget to shift their flight into the most advantageous formation the umpire can penalize them by increasing their delay at datum. Similarily when faced with several possible datums (see form no. 15) if they don't ascertain quickly which one is valid, they will lose more time.

Time Delay Subroutine, (Fig. 7). In this subroutine the umpire determines the time delay for the flight prior to reaching datum. To do this he draws a random number from the table. The time delay then is based upon a random selection from one to ten minutes. The total time delay is the sum of this random number plus any increase brought about by penalties assessed the players earlier in the game.

Sub. Escape & Environment Subroutine, (Fig. 8). In this subroutine the umpire determines what escape track the submarine will use in the game. He draws a random number and chooses the escape plan whose number corresponds to the random number.

To determine the environment or water conditions that the players will be faced with at datum the umpire again draws a random number. If the number is less than or equal to five he will use the environment overlay number one. If the number is greater than five he will use number two. These environment overlays will determine which, if any, false contacts are generated by the helicopters in the tracking phase.

Search Plan Subroutine, (Fig. 9). In this subroutine the umpire simulates the fixed wing aircraft informing the players of the datum position and their time delay in reaching datum (see form no. 16). He should also indicate the datum position on the game board at this time and set the clock to the time delay. He should inform the players that all times at datum will be based upon the first datum time. The players will be required to designate a search plan that their flight will use at datum. If they fail to

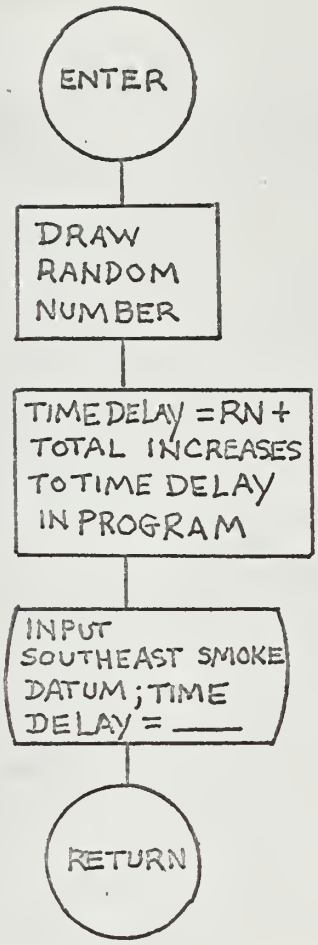

Figure 7: Time Delay Subroutine.

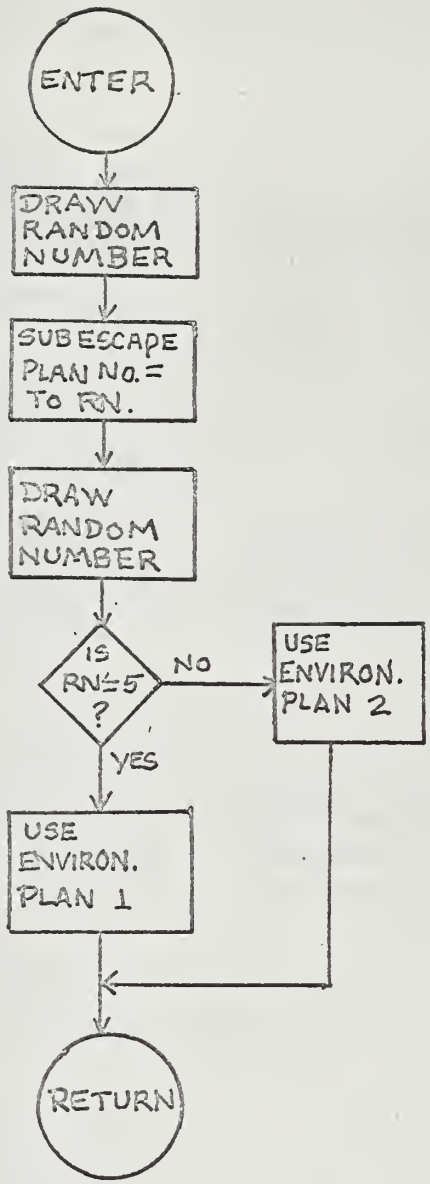

Figure 8: Sub Escape and Environment Subroutine.

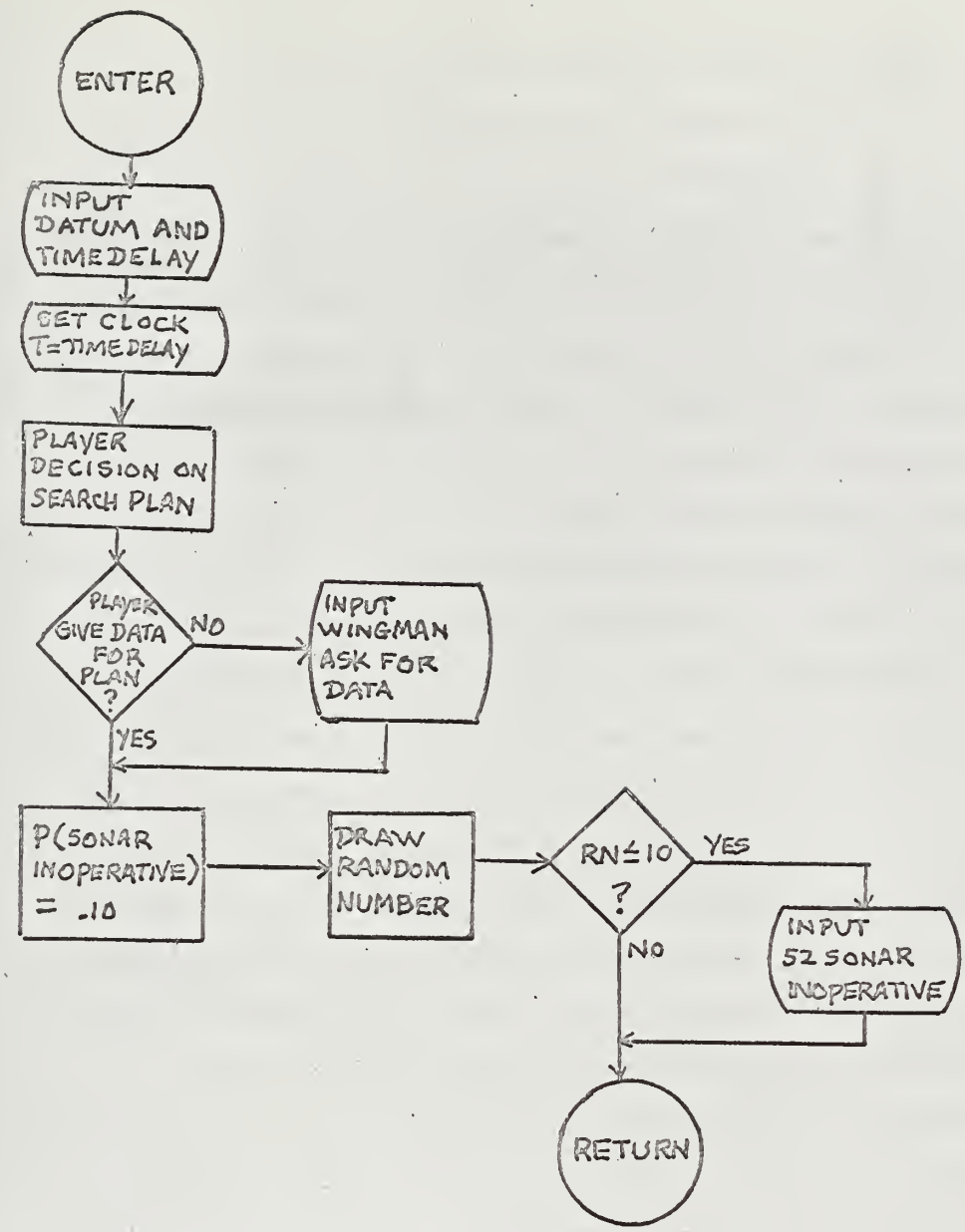

Figure 9: Search Plan Subroutine.

communicate pertinent data to the flight, the umpire can simulate their wingman asking for this data over the radio (see form no. 17). Once the plan is decided upon the umpire can determine if one of the helicopter's sonar will fail to operate by drawing a random number. If the random number is less than or equal to ten the umpire can inform the players that 52 has reported his sonar inoperative (see form no. 18).

Tracking Subroutine, (Fig. 10). Now that the players have determined what search plan they will use the umpire should have them plot each helicopter's position and time on the game board with a grease pencil. The umpire then takes the game board into another room and places the submarine escape track and environment overlays on the game board. Noting the helicopter's position in relation to the submarine's position, corresponding to the clock time, he determines if the helicopter has sonar contact by placing the Sonar Detection Probability overlay over each helicopter. If either the submarine or a false target is within one of the rings of probability, the umpire draws a number from the random number table. If the number drawn is less than or equal to the number representing the probability of contact for that ring, then the umpire will inform the plays verbally of the contact and its position from the helicopter holding contact (see forms no. 20-23). If no contact is generated for any particular minute of time, the umpire should advance the clock one minute and go through the same procedure again to determine if any of the helicopters gain contact. Unless the players request that a helicopter move sooner, the umpire will continue this procedure through six minutes. At the end of six minutes he will ask the players to indicate new dip positions on the game board. The umpire will then determine if contact is generated from these new positions. If they are unable to generate contact the umpire should allow the players approximately thirty minutes in the tracking subroutine. If they do gain and hold contact then the umpire can take them on to the attack subroutine. However, if contact is not generated, he should skip the attack subroutine and go to the return flight subroutine.

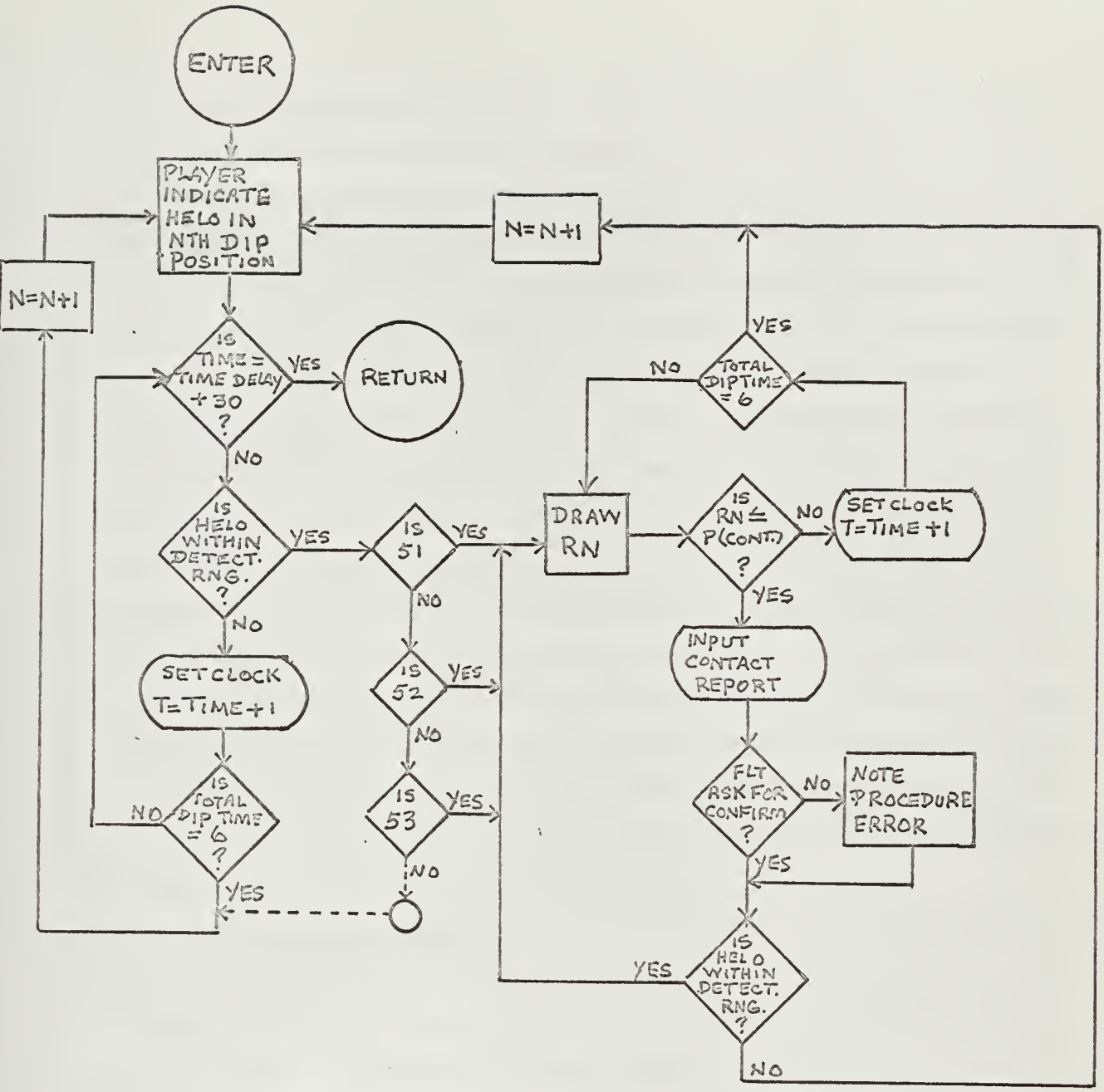

Figure 10: Tracking Subroutine.

Attack Subroutine, (Fig. 11). If the helicopters are holding contact the umpire can simulate the situation where the flight leader is told to attack. The players are then confronted with the problem of what type of weapon they choose to drop considering the situation (see form no. 24). Once the players choose the weapon they are asked to specify under what conditions they will drop the weapon (see form no. 25). The umpire compares this with the recommended drop conditions. If the conditions are not proper then he will penalize the players by decreasing the probability of a kill by 0.5. The players are then requested to indicate a drop position and time on the game board based upon the latest tracking data from one of the other helicopters (see form no. 26). The umpire then compares this position with the submarine's position and a suitable overlay representing the probability of a kill for that particular weapon. This probability must be adjusted for the drop conditions specified earlier. If there is a probability of a hit, the umpire draws a random number and compares it with the probability of a kill. If the random number is less than or equal to the probability of a kill then the players are informed that the last attack was evaluated as successful. (see form no. 27).

Return Flight Subroutine, (Fig. 12). This is the last subroutine of the game. In this subroutine the players will be asked for a decision on what course, speed, and altitude they will use to lead the flight home (see form no. 28). If they have forgotten about the fog bank they encountered on the way out, the umpire can test their decisions and ascertain the probability of a midair collision in the same manner as he did in the Flight Out Subroutine. Once this is done he can have the flight sight land (see form no. 29) and see whether or not they will report they have reached land to the task unit commander. Upon the completion of this subroutine the umpire and players can begin the critique phase.

3. Critique phase - The final, and probably the most valuable, phase of the game is the critique phase. In this phase the umpire reviews with the players the actions that they took during the game in the order

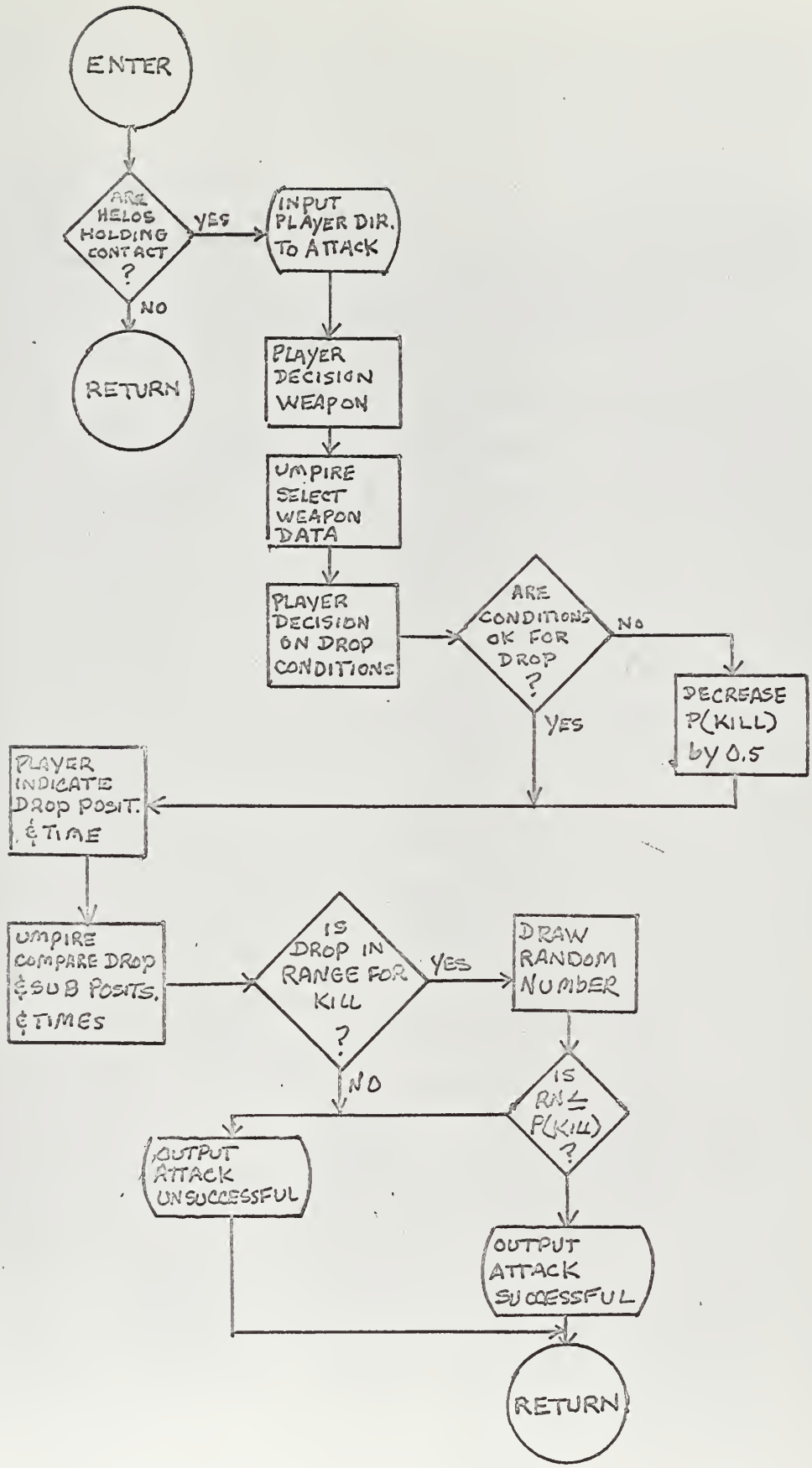

Figure 11: Attack Subroutine.

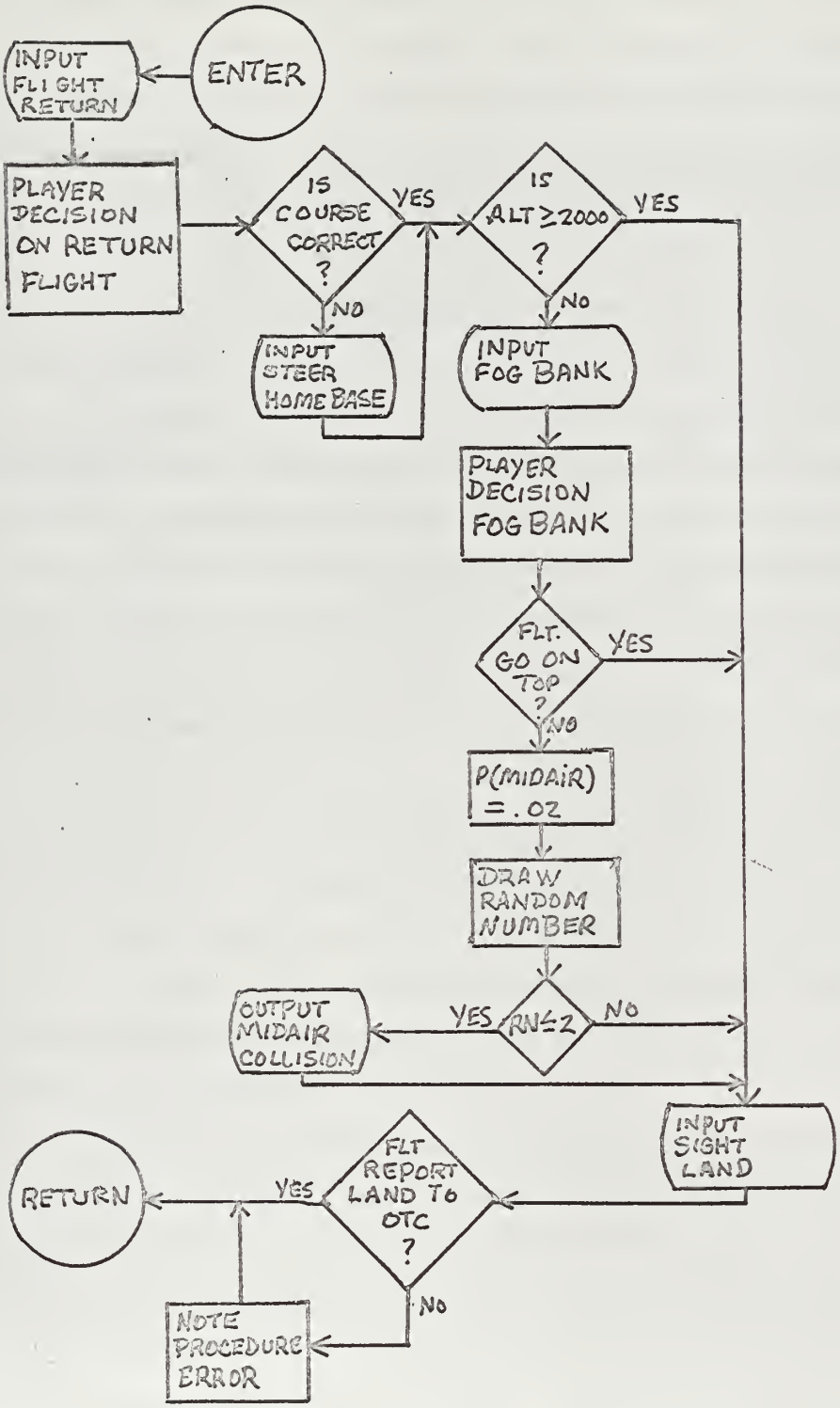

Figure 12: Return Flight Subroutine.

they were taken. Every effort should be made during this phase to encourage a free flow of thought and understanding of the concepts and principles involved. The umpire should attempt to lead the players into a discussion of the concepts rather than just criticize the players' actions during the game.

Conclusions and Recommendations.

The benefits of the game are to be gained in the interest and enthusiasm that is instilled in the players. By presenting concepts and procedures in a sequence and having the simulation unfold before him, the player is allowed the advantage of making the decisions for himself without the risk of a loss because of a poor decision. Perhaps the most unique advantage that is derived from this type of training is that the player is allowed to benefit from his mistakes without actually making them in the real world. The adequacy and ramifications of the player's decisions should be the subject of discussion for the players and the umpire during the critique. Care should be taken to prevent this discussion from reverting into a lecture by the umpire, rather than a free interchange of ideas and an investigation, by all the participants, into the methods and procedures approved by the squadron.

One conclusion that can be made about this game is that its value lies in the fact it is a training aid and not an analytic tool. Valid analysis of the effectiveness of search plans and tactics is, and should be, the subject for more sophisticated models.

One recommendation is in order. This game deals only with the problem of a flight of three helicopters leaving a specific airfield, proceeding to an exercise and returning home. The style of the ASW game lends itself to the various ASW situations that helicopter squadrons can encounter (i.e., carrier-based operations, sortie and harbor defense operations, etc.). It is recommended that further study be given to developing games similar in nature to this game but which encompass the other types of operations mentioned.

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APPENDIX

ASW SIMULATION

Introduction

The purpose of this exercise is to familiarize the unqualified junior officer helicopter pilot with the general procedures applicable to an ASW training situation. The use of war games as a training aid is not new to the military service. This particular simulation is a manual war game and is monitored by an umpire. Certain restrictions to manual bookkeeping will require some short time lags to occur, especially during the datum area phase of the game. This will of course decrease the realism of the simulation somewhat but should not affect the basic concepts being presented.

ASW Simulation will be divided into three separate phases:

1. The briefing phase - This phase will consist of a detailed briefing much like the one you would receive prior to an actual mission. At the end of the briefing, one of the players will be required to get up and give a flight leader's brief just as though he were the flight leader of a flight going on an actual mission. In the exercise the players will play the part of a flight leader. This phase should last approximately fifteen minutes.

2. The game phase - This is the phase where we actually play the game. There are two players and one umpire. The players will be provided with equipment that is normally available to them in the cockpit (i.e., TACAID, plotting board, computer, etc.) along with an ASW game board, grease pencil and implements to plot your position, search plans and attacks. The ASW game board consists of a grid plot. The squares on the grid will equal 200 yards on a side.

Since the game requires manual inputs, the umpire will hand you a problem form or information sheet which will contain some information. You will be provided with blank Decision/Communications forms. Once

the umpire gives you a problem form input, you will be allowed approximately one minute for a decision and about one minute to write out your decision on the Decision/Communication form. A simple example may be in order here. Suppose you were handed the following problem by the umpire.

Problem - You are the leader of a three plane flight of helicopters. You have just taxied out onto the mat and your flight has checked in with you on tower frequency. The course in use is 27 and you desire your flight to take off together, what do you do? Your answer may be something like this:

Decision (1) Call tower for take off instructions for my flight. Inform the tower of my flight number and that we wish to depart seaward.

Communication: "Tower, this is 51, request take off for a flight of three. 52 and 53 are my playmates. Our flight numbers are 14, 15, and 16. Request clearance seaward for my flight after take-off."

Since both of the players would actually be in the aircraft and would, in reality, be assisting one another they can divide up the duties of decisions and communications as they desire. It is intended that both players participate in the decision making and communication process. If you cannot agree on any particular point make a note of this in the remarks column on the form.

Once you reach the datum area, you will be required to mark the helicopter positions and the time delay next to each position on the game board with a grease pencil. Any other points of interest may be marked on the game board by the player. Try to make all marks on the game board neat and legible since this will assist both you and the umpire in the critique after the game. Since the umpire will be required to place some overlays on the game board he will have to take the game board into the next room at times to assess the probabilities of sonar detection and attacks with weapons. Keep a running log of time delay and sonar contacts just as you would in the aircraft. The umpire will inform you what the clock times represent. This phase should last about one hour.

(3) The critique phase - This is the final phase of the game. In this phase we will analyze the data collected and discuss what you did during the game. In this phase we will see what effect your tactics had upon the submarine and the probability of contact. Hopefully this phase will pick up any of the loose ends and tie the exercise into a complete package.

Unless there are any further questions about the mechanics of the exercise we will begin phase one.

ASW SIMULATION

Scenario

The Squadron has been assigned to operate with CTU____ in a combined ASW exercise off the coast of California. The operating area is _____. The bearing and range to the center of the operating area is 275 degrees mag. 57 miles. The units in the area are CTU_____ TU_____. CTU_____ is aboard (enter call sign & number). The other surface units in the area are (enter call sign & number) and (enter call sign & number). There will be 3 fixed wing aircraft in the area. They are 34, 35, and 36. 34 is the flight leader. Your flight is assigned 51, 52, and 53, your aircraft is 51.

The weather at home base is 1000 scattered, 7 miles vis. in light haze; the temperature is 68 and the dewpoint is 65. The altimeter setting is 29.96 and the wind is from the west northwest at 7 kts. The weather at home base is forecast to deteriorate to a 1500 broken ceiling 3 miles vis. in haze within the next 2 hours and should remain that way for approximately another 12 hours.

The sonar conditions are predicted to be (insert appropriate data on sonar conditions).

Communications frequencies are 327.2 (primary) and 284.6 (secondary) with 5125 HF as a back up.

The exercise submarine is (enter call sign & number) a (enter type) type submarine. Submerged speed is (enter speed) for (enter time). Test depth is (enter test depth).

Ordnance - Use (enter type) pdcs, use standard attack signals to indicate attacks. VS aircraft will use the same attack signals. Surface units are authorized to use practice weapons and will signal their intentions to do so on the primary communications frequencies.

The weather in the area is forecast to be clear with 10 miles vis. and the wind should be from the North at about 10 kts.

Near land is 330/41 miles (enter name of area) Near field is 332/48 miles (enter name of field) tower frequency is 360.2 or 340.2.

Problem

What type of formation will you use enroute to the exercise area?

Form 1

Problem

What course and speed will you fly to the exercise area if you have 30 minutes to get to the area after take off?

Form 2

Problem

You receive this transmission over the radio:

"51 THIS IS _____, I THINK WE ARE OFF COURSE, OUR COURSE TO THE AREA SHOULD BE _____."

Form 3

Problem

You receive this transmission over the radio:

"51 THIS IS _____, I THINK WE SHOULD INCREASE SPEED TO _____ TO GET TO THE AREA ON TIME."

Form 4

Problem

Twenty miles from home base you and your flight encounter a low lying fog bank that extends up and down the coast as far as the eye can see. The tops of this bank appear to be about 1500 ft. Because of the angle of the sun you are not able to determine just how close to the water the bank hangs. What will you do?

Form 5

Problem

Your flight just went IFR. What do you do?

Form 6

Note

YOUR FLIGHT WAS NOT BRIEFED FOR INADVERTENT ENTRY INTO IFR CONDITIONS AT THE BRIEFING. YOUR WINGMAN TURNED INTO YOU INSTEAD OF AWAY FROM YOU. THE PROBABILITY OF A MIDAIR COLLISION IS ASSESSED TO BE .02. STAND BY FOR RESULTS.

Form 7

Note

OUCH ..... HE HIT YOU ... A MIDAIR JUST RUINED YOUR WHOLE DAY.

Form 8

Note

HE MISSED. CONGRATULATIONS ..... HAVE YOUR FLIGHT JOIN UP ON TOP.

Form 9

Problem

Once you have switched your flight over to tactical frequency (primary) you hear 34 call 35 and report a contact. Seconds later he calls for his flight to go to (indicate type plan). The following dialogue continues over the radio:

(enter an appropriate dialogue to indicate the fixed wing have contact. Use up-to-date code words or table to test players knowledge.)

"ROGER 34 HOLD YOUR 153/17 MILES, PRESENTLY ENROUTE TO YOU."

"ROGER (enter destroyer call sign)."

Your flight is still on top of a broken layer of clouds and you do not hold any of the exercise units visually, what do you do?

Form 10

Problem

One minute later you receive the following radio transmission:

"51 this (insert destroyer call sign), WHAT IS YOUR PRESENT POSITION? (insert request for a proper report by flight leader)."

Form 11

Problem

(insert destroyer call sign) calls you and tells you to proceed to the area where 34 and 35 are. You still do not hold 34 and 35 visually. What do you do?

Form 12

Problem

You received this transmission over the radio:

"51 THIS IS _____. I DO NOT HOLD YOU VISUALLY, SHORT COUNT FOLLOWS, ONE, TWO, THREE ....."

Form 13

Problem

The weather has cleared and you sight several smoke markers in the water about 7 to 10 miles ahead. There are two fixed wing aircraft circling the smoke markers. The wind appears to be from the North, at about 10 knots. What do you do?

Form 14

Problem

There are seven smoke markers in the water at datum.

What do you do?

Form 15

Problem

34 calls you and informs you that the southeastern most smoke is datum. Your time delay upon reaching datum is _____.

Form 16

Problem

You receive the following transmission over the radio:

"51 THIS IS _____, WHAT IS (enter request for data on search plan)."

Form 17

Note

52 informs you that his sonar is inoperative.

Form 18

Note

The fixed wing aircraft are still in the area. The destroyers are still several miles from the area.

(Note: This form is to be used at the discretion of the umpire to provide added information to the players).

Form 19

Problem

You receive a radio transmission from _____ indicating that he has a sonar contact bearing and range _____/_____.

Form 20

Problem

You receive a radio transmission from _____ indicating that he has lost contact. His last bearing and range was _____/_____.

Form 21

Problem

Your sonar operator reports a sonar contact bearing _____ degrees _____yards. What do you do?

Form 22

Problem

Your sonar operator reports he has lost contact, the last bearing and range was _____, _____.

Form 23

Problem

The fixed wing have confirmed _____ contact. You are told to attack. If this were a real war situation what type of conventional weapon would you use?

Form 24

Problem

(insert a request for the player to indicate under what conditions he will drop the weapon.)

Form 25

Problem

Allow one minute to leave your dip position and another minute to make your attack. Mark the position of your drop on the game board and note the time of the drop.

Form 26

Note

_____ calls you to tell you that your last attack was evaluated as a _____ by the submarine.

Form 27

Problem

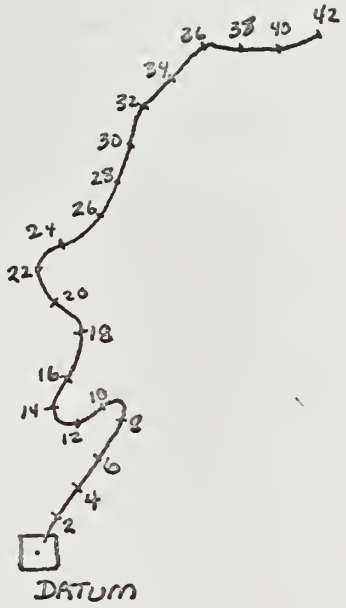
_____calls you and tells you and your flight to return to your home base. What course, speed, altitude, and formation will you use to fly back?

Form 28

Problem

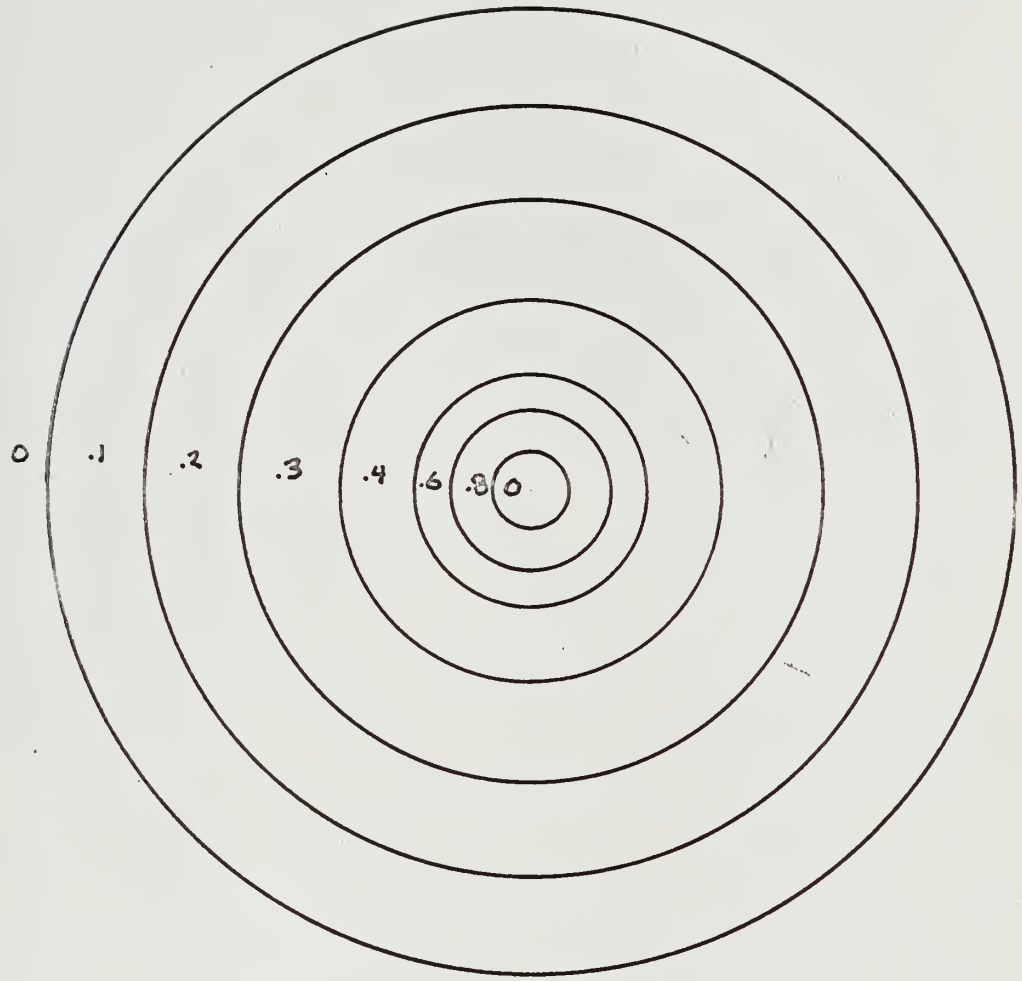
You sight Point Loma about 4 miles ahead of you, what do you do?

Form 29



Example of Submarine Escape Plan overlay.

(Not to scale)

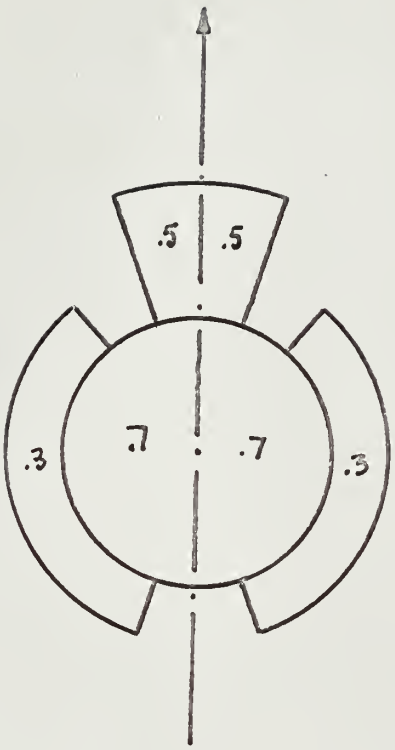


Example of Sonar Detection Probability overlay.

(Not to scale)

Example of Environment overlay #1. (not to scale).

Example of Environment overlay # 2 (not to scale).



Example of Weapon Effectiveness overlay (not to scale).

DECISION

COMMUNICATION

REMARKS

Example of Decision/Communication form.